

Still Alive With Sir Clive!

# ZXir QLive Alive!

The Timex/Sinclair North American User Groups Newsletter

Volume 9 No. 4

Winter '99

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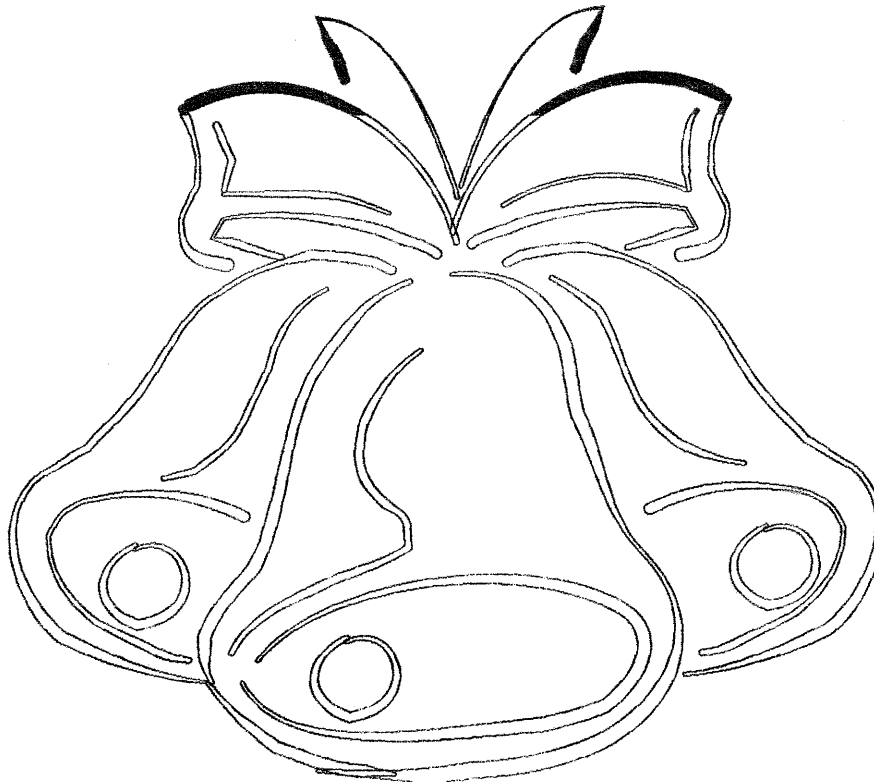
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**IT IS THAT TIME AGAIN TO RENEW**

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Established 1991 The Timex/Sinclair North American User Groups Newsletter

# T/SNUG Information

We wish to support the following platforms : ZX-80/81, TS-1000, Spectrum, TS-2068, Z88 and QL. If you have any questions about any of these fine Sinclairs, contact the:

## Chairman

Chief Motivator  
Donald S. Lambert  
738 Gunnar Ln.  
Forsyth, IL 62535

## Vice-Chairmen

### Tape & JLO PD Library

D. G. Smith  
415 Stone St.  
Johnstown, PA 15906  
814 535-6998

### Z88 Library

Dave Bennett (HATSUG)  
1275 Timber View Dr.  
Mechanicsburg, PA 17055-9146  
717 732-4374

### QL Hacker's Journal

Timothy Swenson  
2455 Medallion Dr.  
Union City, CA 94587-1914  
swensonto@geocities.com

### TS-2068

Rod Humphreys (VSUG)  
10984 Collins Pl.  
Delta, BC V4C 7E6 Canada  
604 583-2819

### QL PD Library

John Donaldson (CATUG)  
835 Foxwood Cir.  
Geneva, IL 60134-1631  
630 232-6147

### AERCO & Z80 Emulator

Keith Watson  
41634 Amberly Dr.  
Mt. Clemens, MI 48038

### BBS ---GATOR---

Bob Swoger (CATUG)  
613 Parkside Cir.  
Streamwood, IL 60107-1647  
630 837-7957 Work 847 576-8068

Any of the above can also be reached by E-Mail through the Club BBS 847 632-5558

## ZXir QLive Alive!

Is the newsletter of T/SNUG, the Timex/Sinclair North American User Groups, providing news and software support to the T/S community in a VOLUME of four newsletters per year, beginning with the Spring (March) issue.

T/SNUG's main goal is to preserve and encourage the use of Sinclair computers by providing an open forum for the exchange of knowledge, building and maintaining of software libraries. Providing vendors, repair service and members with free ad space.

It is the user groups and individual subscribers, rather than the vendors, that provide the pecuniary support for this newsletter. Vendors and developers receive this newsletter free of charge, though contribution from vendors and user groups is gratefully accepted. Please support our vendors and service providers whenever possible.

If you have a problem or you have solved a problem, please share it with the rest of us. No problem will be considered unimportant.

## Editor/Treasurer Publisher

You can keep T/SNUG alive by an annual contribution of \$12 for one VOLUME made payable to Abed Kahale. Send check to:-

ABED KAHALE  
3343 S FLAT ROCK CT  
SIERRA VISTA AZ 85650-6874  
520 378-3424

Back copies are available for \$1.00 each postpaid.

## Trea\$ury Note\$

As of December 15, 1999, we have a balance of \$786.12

## Article Contributions

Send in your articles by disk, hardcopy or mail, e-mail and your inputs to:—

**Abed Kahale**

E-mail: AKahale@compuserve.com

## Welcome

Luke Perry

## GATOR'S

Twisted Pair

To better inform the Sinclair Community, three 24-hour a day BBSs are now provided to serve you. You are encouraged to exchange mail and use the files sections of these boards. Bulletins and ads are available to all.

Q-Box BBS 810 254-9878  
Utica, Michigan

SOL BBS 520 882-0388  
Tucson, Arizona

Club BBS 847 632-5558  
Arlington Heights, Illinois

## Web Pages

<http://users.aol.clubbbs/tsnug/>

<http://www.outlawnet.com/~jboatno4>

If you know the Internet E-Mail address of a Sinclair user, but do not have access to Internet, simply address your E-Mail to GATOR Sinclair on the 24-hour Club BBS and include the name and E-Mail address of the user you wish to reach. Then check the Club BBS from time to time if you expect a reply.

We encourage you to exchange mail and contribute to the UPLOAD section. Call and register using your first, last name and phone number along with a password you won't forget. Write It Down! Do not try to do anything else at this time.

When you call-in the next time, you will have Level 5 security and be able to enjoy full user privileges. The BBS has smaller sections called conferences. Select "J" for "Join a Conference". Select "TIMEX" to get into the Sinclair Section. The mail you then read will only be from other T/S users. Use extension .ART for articles, .ADS for ads and .NWS for news wh- UPLOADIng.

For help, contact the SYSOP, Bob Swoger, by leaving a message, mail, E-Mail or phone. CENG108@email.mot.com

# Input/Output

by *Abed Kahale*

Thanks for the reply!

The article I wrote dealt mostly with obscure formatting commands in the CompuServe mail composing situation. Before I bought this new computer, I was using an old IBM PC clone, the Apex by Epson. Before that, the T/S 1000 with the 32 column screen. CompuServe wasn't the problem as much as the ZCOM software for the Byte-Back modem. So I showed a way to compose off-line and then upload and use reformatting commands to convert text to 80 col. for FAX or other documents. You could always compose on-line in the 80 columns.

But now I don't know if CompuServe still supports those old reformatting commands. I was having problems with my old IBM clone crashing when using certain sections of CompuServe, even when CS was supposed to still support ASCII interfaces.

(My article also showed how to reprogram some keyboard characters and add characters the T/S character set didn't originally have. But this was all with the crazy ZCOM modem software, which wasn't the best.)

I had a problem in trying to figure a way to unpack the input byte on the BB-1 I/O board which would be a binary number, and I just wanted to pick out one bit, (any one depending on what train layout sensor was "on") with only one line of T/S 1000 BASIC. Speed was an issue. There was a way to unpack the whole byte in about 8 program lines, but that took too much time. Here is an example of my program:

```
300 LET B=PEEK Y (Peek Y is the
input byte in binary)
301 IF INT (B/4) <> INT ((B/4) +
0.5) THEN GOTO 315
300 GOTO 300
```

(Line 301 picks out the second bit and breaks the loop.)

I remembered a computer class assignment back in '77 when we had to determine if a number was odd or even, and this came in handy, dividing the number in half and adding 0.5 and comparing it to the number just divided in half, with the integer function rounding off the numbers. The T/S 1000's BASIC doesn't use AND and OR like other versions of BASIC. Perhaps there is an easier way to pick out the one bit, but I was working on this without any help.

I wish the E-Machine was free. There was a possible rebate of \$400 from CompuServe, but here in Hanover there isn't a local access number, so I had to go with a smaller, local company as my ISP, and couldn't use the rebate.

I don't use CompuServe as an ISP since I would have to pay about \$4-6 an hour in telephone long distance charges. The E-Machine was a good deal, the best price I could find with an Intel Celeron and other features. Whole thing cost about \$750 with a printer and software I added so far. Just saw an ad for a scanner yesterday, but it is a low end product and I think my money would be better spent on a better model. Take care,

**Joe Rampolla**

[jprampolla@blazenet.net](mailto:jprampolla@blazenet.net)

Hy my friend

I want know infomations about Timex 1000 Because I have a Micro Z81 (Zilog Z80a) Called TK-85 in brazil. And want used your softwares in my pc (in DOS or Windows ) So I need a emulator Sincalir Timex 1000 at dos or windows. If you can help me ... Thanks

[Castrox@portoweb.com.br](mailto:Castrox@portoweb.com.br)

*I have an emulator for the TS-1000 on a floppy disk. (by Carlo Delhez), I do not know how good it works. Please send your address.*

Hy my friend thanks But how send us money to you ?? And how many?? My adress is

**Antonio Castro**

Porto Alegre , RS

Rua Anita Garibaldi 336/405

Brazil Cep: 90450-000

*I mailed you a disk on 26 September, free.*

Hi Abed,

Here's an email I got today. Know anyone interested?

**Jack Boatwright**

Hi, there.

I had my daughter move back in with us and in the process of cleaning up and making room for herself and her son, she came across my old T-S 2068 computer. I thought I had thrown it out years ago, but I guess was wrong, hmmm?

Anyway, I started browsing the NET to see if I could find any user groups for them or anyone else that might be interested in mine. If you are still in that mode or know anyone who is, could you please refer them to me?? I don't have the power pack or other cables, but I do have the computer itself and a book of 50 programs for it by Roger Valentine.

Please refer anyone to [<yosemitejim@msn.com>](mailto:yosemitejim@msn.com) if they are interested. Thanks very much.

**Jim Mack**

I'd love to have it and will pay shipping.

**William Girnius** [Girnius\\_W@bls.gov](mailto:Girnius_W@bls.gov)

Hi

I remember your name. Now I have a company that makes computerized cutting systems.

[www.LarkenCNC.com](http://www.LarkenCNC.com)

**Larry kenny**

Hi Abed,

Sorry, I forgot to send you my new email address. As of 9/30 the one you mailed the column to will be out of service. Please use the one at the top of this message.

Thanks for the column again. Later,

**Rod Gowen**

Oregon City, Oregon

[ej377@freenet.carleton.ca](mailto:ej377@freenet.carleton.ca)

Hi Abed,

Also thanks for forwarding the note on the guy with the old T/S. I hope my old T/S 1000 holds out for me. The I/O board from Byte-Back was new just about 2 years ago. Without the T/S 1000, I am lost. I rewired an old TI 99/4A

keyboard and soldered the ribbon cable directly to the T/S board. Only problem with the T/S 1000 is how slow it LOADs and SAVEs, but I have gotten used to that. The occasional crash is my only problem, and I usually have a way around that by just "warming" it up before I load my program.

I use all 6 volt 4PDT DC relays for that bank of 15 relays that are directly controlled by the I/O board and they have their own powersupply. As I said before, the 15th relay, on the left in that photo, switches between the two groups of 7. The photodiodes that are used for the input, I have put in one of those pill keeper containers that have 7 compartments. In each compartment I have one photodiode (photoresistor), and one light bulb, either a 3, 6, or 12 volt Christmas tree light that is hooked up to either a reed (magnetic activated) switch with a separate power supply, or off of the Lionel O27 3 rail track AC voltage.

The small SPST relays on the I/O board I use to control the 15 4PDT relays. The only problem with using only one I/O board, (You can use up to 4 Byte-Back boards) is that you can only control one group of relays at a time, so you are limited. I would like to add another I/O board, but I feel that my old T/S 1000, with the T199/4A keyboard, has a lot of hours on it. Take care,

**Joe Rampolla**

Hi Abed,

I had to pull the QXL card from my "main" computer when I upgraded to WIN95 because the version of SMSQ that I have is not fully compatible with it ... i.e., one has to run the computer in DOS only mode.

By contrast, the QLAY emulator happily co-exists as just another DOS program under WIN95.

The first QPC demo would not load on my system ... I got a memory management "error" message.

I downloaded the QPC2 demo a few weeks ago, and tried to run it last week. I had trouble loading it because I was trying to run it from the command line; but, Marcel Kilgus (program author) indicated I should try to LOAD it from the "run" line ... that seemed to work. The first impression is that SMSQ/E is WIN95 compatible.

I am loath to spend over \$100 (closer to \$150, I think) to make my QXL card compatible with WIN95 by paying for the upgraded OS.

I'm not sure if it was SMSQ/E and the QPC2 demo, but my primary system (i.e., WIN95) seemed to become unstable ... could have been what I was doing ...

The obvious advantage of QPC2 vs. QLAY is that the user has access to the floppy and hard drives.

QPC2 appears to be fully incompatible with the PSION programs (the word processor, spread sheet, database, charting program) which came with the original QL. This is NOT good as these remain a strong reason that I use the QL. I'll have to investigate this further before make more statements about the incompatibility.

I'll try to expand my investigation and then write a "first impression" of QPC2 sometime in the next few weeks.

Regarding the stock market, as I think I indicated, I'm not looking for the real bear market to begin for quite a while. I've certainly read enough reasons why it could start at any time ... including next Spring ... I just think it will take longer for everything to fall into place.

There may be some residual Y2K problems which

might soften the market next Spring ... but, I think that will present itself as one of those "buying opportunities" for the brave of heart who have deep pockets.

As I said, I think we are in a plateau phase in which we may see a few deep crevasses before coming to the plateau's other edge.

**Al Feng**

From: MKandrac@aol.com

Is there any way to get parts or programs for the Timex Sinclair 1000. Below is something about Mike:

Location: Kissimmee, FL

Birthdate: April, 1967 Sex: Male

Marital Status: Single Hobbies: Computers

Computers: Pent. Occupation: A/C Installer

Personal Quote: if you fail try again and give second chances.

**Mike Kandrac**

Mike, check out

<http://members.aol.com/clubbbs/tsnug/> and look up Jack Boatwright. ---GATOR---

Hi Abed,

Don Lambert has now sent me all his TS equipment (I paid the shipping costs and it was significantly over \$300!). Whew! I still must get everything organized.

Alvin Albrecht and I made some 2068 Spectrum ROM boards this summer (Alvin did the design and had the boards manufactured). I got the parts and have them nearly complete but due to the other stuff I told you about have had to put the finishing of them on hold for a while. I still need to solder a capacitor on some of the boards and finish burning the EPROMs (I traded for the EPROMs with Don Walterman). I hope to get back to them in the very near future.

Rod Gowen put me in contact with a nice gentleman who wanted to sell his 2068 items (which I purchased). Included were 2 LarKen interfaces. I am sending one of them to Larry Kenny and the other one is available if someone wants it. It won't be free, though. As I mentioned I had to buy them. I will include the manual and a few 5 1/4" disks with LarKen programs. Take care,

**Jack Boatwright**

**Sir Clive Back!**

Sinclair Research, the company run by Sir Clive Sinclair, has just released what they say is the worlds smallest AM radio. Around the size of an acorn, the **Sinclair Z1 Micro AM Radio** fits in the ear and will tune the whole medium wave band, 530 - 1600 kHz. Sir Clive said; "Developed primarily with news and sports listeners in mind, it will enable you to listen to your favorite station wherever you are and so discreetly that even the person next to you will be unaware that you are using it." The Z1 costs £9.95 including S&H and is available by mail order from:

Sinclair Research

Vector Services Div.

13 Denington Road

Wellingborough, Northants NN8 2RL, UK

Tel: 01933 279300.

From ZX-Team

Hi Abed,

I made a comment to Alvin about people asking me for Spectrum emulator cartridges, like the old OMNI-EMU,

etc. Alvin and I discussed it and I put out feelers to a few people and the response was positive so Alvin designed a board that will fit in the 2068 cartridge slot and had them produced, I ordered the parts needed and have them nearly all soldered, but still need to finish making the EPROM's for them. We'll sell them for cost (\$20-25).

**Jack Boatwright**

## Sinclair E-Mail List

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## A visit to Larry Kenny's Page

### Wood Working Sign-making & Manufacturing

LarKen Automation is a manufacturer of computerized three axis CNC router systems for the woodworking, sign-making and manufacturing needs. LarKen routers are engineered for accuracy, performance and long life.

We have 3 models of industrial CNC routers, all featuring heavy steel frames with under-table rack and pinion drive, cross-shaft for high rigidity and balanced drive. Other features are cast aluminum side gantry supports and an extra wide gantry to allow 2 heads to cut full table width. These routers have 6" of Z axis clearance with 7" of travel. Our powerful 3 axis controller with oversized motors give fast performance.

We also manufacture 2 sizes of very affordable routing systems called the CAM-TOOL series They are ideal for industrial, home and educational applications, and are very solid and accurate. Our 3 axis micro-step drive provides smooth reliable

positioning. Two sizes are available: the Cam-tool 2424R with 24" x 24" x 4" xyz travel and the Cam-tool 4040R with 40" x 40" x 5" of xyz travel. They are also available with 8" of Z axis travel

Lark's L-CAM software is included with the router systems. This deluxe Turn-Key control system and allows user-friendly control of the router table and has numerous features such as graphic display of 3D tool-paths, importing and editing of HPGL DXF and 3d GCODE formats, tool offset and tool fills, and basic drawing commands. You can stop the router at any time and go forward or backward any number of contours, automatic multi-pass, and *smooth vector look ahead* motion control. Other Stuff :

Routing and Sign Sample pictures  
Spindle options Router Accessories  
LarKen Sign-Surf 3D ... 3D Sign Modeling for Windows  
Maxx-3D 60" x 100" x 36" XYZ Modeling System

Educational Router packages  
Software Driver Download page

LARKEN AUTOMATION

3205 Swansea Cr. Unit 16

Ottawa, Ontario

Canada K1G-3W5

(613)-738-0998 Fax (613)-738-9407

www.larkencnc.com

For a price quote or more information please leave an e-mail message with your address and phone number.

<larken@storm.ca>



I use the T/S 1000 to control 15 single pole, double-throw relays to automate my layout. The eight outputs and eight inputs of the I/O board aren't enough, but I have some things wired in combinations so I get more usefulness in what they used to call "relay logic". I use the 15th relay to switch between 2 "banks" of 7 relays.

The eight inputs are essentially "track sensors." 8 photodiodes are hooked up to the Byte-Back's I/O board, and a small light bulb will light and affect the photodiode (like an electric eye), controlled by a magnetic switch in the track, or by grounding an insulated rail, telling the T/S where a train is. The rest is just program instructions in T/S BASIC. POKEs tell the I/O (input/output) board what relay(s) to turn on or off, and PEEKs are how the computer knows where the trains or automobiles are. The rest is just simple program lines.

The only problem I had was the speed of the T/S 1000 unpacking the input information. So I remembered something from an old computer class and got it down to one line of T/S BASIC. But I haven't done the best version of the program yet since the train equipment I add means new program lines and changes, and that's work with the de-bugging and timing issues. I use a lot of PAUSEs. Also, I run the old T/S 1000 in slow mode only since I don't know if the I/O board can work with the fast mode, and then my timing is different since I seem to remember that PAUSEs are shorter in the fast mode.

**Joe Rampolla**

Does there exist a schematic for the T/S 1000? If so could you please let me know where I could get a copy.

Thank you,

**Douglas Dunbar**

didunbar@prodigy.net

attch. <zx81.jpg> I will mail you a copy if you give me your mailing address.

**DOUGLAS L. DUNBAR**

4515 5TH STREET NW  
ALBUQUERQUE, NM 87107

I did send the LarKen interface from Don Lambert to Larry Kenny. He has not indicated that it has arrived, but it should have been there last week. Take care,

**Jack Boatwright**

dear friends (as received)

I was very happy when I received the diskette contends the emulator ts-1000 ha more than 4 years I tried to discover some program that is rotated my old scrpts in basic sinclair. the program of the emulator is really very good.

I am including a small contribution. It is a file of the word that can be printed paper it will help the users to visualize the keyboard of the ts-1000 better.

here in Brazil the ts-1000 called her TK-85 it is it was a success at that time (1982) it was my first contact with the world of the computer science and never more I forgot those nights wakened up to type lines and more lines of programs, and in the morning it didn't get to save anything in the cassette, but everything well began to type again.

today it seems funny when he/she doesn't get lost anything else in a PC, but on those crazy initial years, when we got to save something and later to read again was she he/she glories:~))

thank you very much for the program and he/she would like to know I should be paid something for you register it, a great hug for everybody.

**Antonio Castro**

rua Anita Garibaldi 336/405

Porto Alegre - RS

Brazil Zip: 90450-000

castrox@portoweb.com.br

Dear friend, (edited version)

I was very happy when I received the TS-1000 emulator diskette. For 4 years I have been looking for a program that will read my old BASIC programs. The emulator works really good.

I am including a small contribution. It is a Word file that can be printed in the newsletter, it will help the users to visualize the keyboard of the TS-1000 better.

Here in Brazil the TS-1000 is called TK-85 it was a success at that time (1982). It was my first contact with the world of the computer science and never forgot those nights I typed lines and more lines of programs, and in the morning I wasn't able SAVE anything on the cassette, but I started to type again.

Today it seems funny we don't get to loose anything in a PC, but on those crazy initial years, when we got to SAVE something and later read it, was glorious:~))

Thank you very much for the program and we would like to know if I should pay something for mail it, a great hug for everybody.

**Antonio Castro**

Mr. Swoger

Please accept my \$12 check for membership in Timex/Sinclair users Club. I am excited to find the web site. I am a NASA PR person and software engineer at the Cernan Space Center of Triton College in River Grove IL. My wife & I would like to participate in your club & Parties. Looking forward to receiving the newsletter! Here are some numbers for you. Thanks, Dean

**Dean B Mikolajczyk**

4714 Arbor Drive # 207

Hi Abed,

Jack and I have put together Spectrum emulator cartridges for the TS2068 so that won't be of any help to Don (I read that he gave his 2068 away).

But there are two good TS2068 emulators available: Multimachine (Windows) and Warajevo (DOS). The latter is better for programmers since it has a monitor/disassembler built in but if he doesn't use that, Multimachine is probably a better choice. Both are available from WOS.

I might as well tell you my new address while I have your attention :-). I did get the latest issue of ZQA (it was forwarded to me), but in future you should use:

**Alvin Albrecht**  
1532 W. 57th Ave  
Vancouver, BC  
Canada V6P 1T2

Hi Abed,

I sent the money to Don in installments as boxes were shipped. The money came out of my pocket. I offered to pay shipping and he accepted. At the time neither of us thought it would cost that much, but spread over a few months it wasn't too draining on finances.

I am not concerned with the cost. What I really need to do is get it all organized and a list to you with what is available. Some of it I will keep in my collection, but most of it is available.

I appreciate your concern,

**Jack Boatwright**

Joan

Received your modem, assume it's a donation to the RMG/TSNUG project T/S surplus growing here at the farm. It arrived in great shape, will add it to the list. Amazing, isn't it that it was worth what a full-blown 56K PC modem now sells for. Be of good health,

**J. Shepard**

I sent Boatwright a Wickes ball today and have already packaged up a joystick for mailing on Monday. Shepard received the modem I sent him and said it arrived in fine condition. He reminded me that it cost more than the fastest modem today--yeah, but only paid \$100 for my TS2068, not over a thousand dollars; most things for TS2068 were so cheap and so far ahead of the Apple II contemporary to it. Boatwright offered to pay shipping on my stuff too but I had already told him absolutely not. I do not think he should be paying that at all out of his pocket. He said he was only 52 years old--just a puppy.

**Joan Kealy**

It is called

**Window Print 2000**

I think there was a Spectrum version but I am looking for the TS-2068 version ... on tape is possible ... I don't know the publisher off hand but zebra Systems used to sell it.

Maybe one of your users has it? Also please send me your US Mail address so I can get back on he active Subscriber list for that newsletter you publish ... also ... in this day of online stuff ... would you happen to know if the "newsletter" is in WEB format ??

Thanks ... wishing to hear from you soon ... also

please CC the info to this address because sometimes this one here on hotmail doesn't work.

**Robert Gilbert**

12A Nathan Rd  
Waltham MA 02154

weena@netzero.net mcs\_rlg@hotmail.com

This program :

10 POKE 22528+RND\*767, RND\*255

20 GOTO 10

shows less non-random behavior than the original two-line programs of last issue's letter. Besides, the 2068 accommodates 8-bit numbers (less than 256 !)

Also, isn't there an (unseen) column 33 in every display line for the 2068 ?

It holds the NEXTLINE character, or something like that.

So, the cyclic nature of the previous displays are explained, either by the EOL character, or the extra range of attribute values (from 128 to 255,) or both !

KEEP ON TIMEX'n

**David E. Lassov**

2590 N. Jordan DR  
Tucson AZ 85745-1132

Dear Abed,

This is not a T/S computer by far. I have read at Compaq's manual, the version of Microsoft Win 98 and a book I picked up at an outlet mall before I even knew what I was going to buy. That book is The Complete Idiots Guide To Windows 98. By trying to read in each book and doing a little mental translation I have learned a little. Currently the learning curve is flat and some day I will start to really learn and then I will be more into the PC computing.

The computer is a Compaq 5715 which I bought at Sam's Club. The processor is a Celeron 466 and came with 64 MB memory, 32X CD-ROM drive, 2 GB hard drive, 100 MB Omega zip drive built in, 56K V.90 modem, 128K L2 pipeline burst cache. Compaq internet keyboard, Compaq wheel mouse and JBL powered speakers. To that I have added a Lexmark Z11 color printer.

*(You've got a real good system)*

You don't just bring it home and plug it in, there are such things as extras that you forgot or didn't think of. I have made several trips on foot to Staples (about six blocks away) for this or that doodad that I needed. At least they are cheaper than Radio Shack if they have the item. Masako is fretful and asks "now what are you going to buy?"

Well, I am in WordPad but I can't get the printer to print any other fonts or type size but this. This is the default and I haven't found the way to override the default. This morning I installed a surge protector and lightning protection for both the power and the telephone line. I neaten up the maze of cables with a spiral deal for that purpose. Beyond that I used regular string to tie the cables together. Now it doesn't look like an electrician's nightmare.

I would use Word but I don't have a manual. Sam's Club has a manual rather Word For Dummies but I just didn't see spending that much at that time. I went to the Book Barn which is a place two sell and buy used books and found a book for \$5.00 that I thought would help me but! it is for programming Word not to help use it. The book is Word Developer's Kit and runs to a thousand pages. Guess I could leave it on my book shelf to impress people. I will check the local library and maybe they have a copy. If not I can always buy a copy of Words For Dummies or an Idiot's Guide To Word.

This keyboard has a lot of doodads that I am not sure of what they are for. After I use all the dedicated keys maybe it will make sense to me. Just like the mouse - it has a wheel on the top

but so far I have not seen using it affect anything. I just tried it and it seems to jump a page of text or a window of text. I guess it is a try it you might like it. I really miss the 2068.

**Is there a T/S 2068 emulator and programs on CD-ROM?** If so, who has it and how much is it? I have some Spectrum stuff on CD-ROM but have not taken time to try to LOAD it. I guess with 12 GIG hard drive I am able to have a lot of stuff there. If that fills up I can put on either a bigger hard drive or else put on another hard drive. If I ever open the case I will want to install more memory. Take care and I will be around for a while yet, or so I plan.

Sinclairly yours, **Don Lambert**

Abed

Joan (Kealy) has sent a joystick, trackball and some Byte Power tapes. I offered to pay the shipping costs for whatever she sends, but she emphatically let me know that I am not to reimburse her.

**Jack Boatwright**

Abed,

Since we last were in touch I have moved twice and have been busy at work. I am looking forward to receiving the Newsletter and being kept informed of what is happening in the T/S community.

By the way, do you know if anyone in the community is working on hardware for the **TS-2068**, specially a

**floppy disk drive interface**

of some kind?

**Luke Perry**

3708 NE 109th Ave. 115

Vancouver, WA 98682

doidy34@yahoo.com

*There are a LarKen and an Oliger disk drive interfaces that maybe available from one of our members.*

Maybe you could do me a favor and add in the newsletter that I am also looking for a

**Microdrive system for the TS-2068, I believe it was made by A&J.**

I sure would appreciate it! I am looking forward to my first copy of the newsletter. < Luke

Sid Shapiro wrote:

I don't know what T/S machine you have - Can you tell me what color it is?

As for hooking one up to an IBM platform -- no one has felt the need to try that but many have passed files back and forth. T/S2068's and QL's can read IBM formatted disks and pass text files ok.

Be sure to visit our sites at: [members.aol.com/clubbbs/tsnug](http://members.aol.com/clubbbs/tsnug) and [members.aol.com/clubbbs/catug](http://members.aol.com/clubbbs/catug)

====GATOR====

On the 2068 system, my AUTOSTART disk drive has a light, that goes ON, but nobody's home. So, I called **Computer Classics**, as listed in the last issue of ZQA!

Dan's too busy as an electrician, or something, to repair my DSDD drive.

**He says, the ad is running without his authorization, and that he cannot accept any repair jobs.**

That leaves us with two problems : who is going to perform the work for people, who call Dan; and, who can I

call to fix my 5.25" drive ?

**David E. Lassov**

*He could have told me not to run the ad.*

Dear Abed,

I received your card Saturday and I have looked for the card from the disk drive repair service but for the life of me I can't find it. I know that I did not throw it away but just where did I put it? BUT! it seems that I did write something in ZQA about using the service and gave the name and address. I did not keep the back issues of ZQA when I moved.

However, I can say that even without a repair service that Lassov is not without a working drive. I did move four drives with me for some reason which I now know that have no use for me. So if Lassov will pay shipping I will send them off to him. I have four drives in a wooden case that I made. I can send the whole deal which is a heavy deal or I can just send the one or two that he wants. The drives are a 40 track DSDD full height drive, a half height 40 track DSDD drive, a half height 80 track DSQD drive and a 3.5 80 track DSQD (or 720K) drive I presume that he needs the drives for his T/S 2068 LarKen, these were working before I moved with the Oliger/LarKen disk interfaces. I have not tested them since I moved since I did not have an interface or computer to test them on. According to my note on the address card he has an 80 track 5.25" and a 3.5" drive but that was back then.

**Donald Lambert**

Regarding my AUTOSTART drive, a DSDD where the light goes on when selected, but nothing happens, I have searched ZQA for all of Don Lambert's contributions from Spring 1977 on. Can't find any reference to disc repair, or anything even close ! Also emailed George Chambers and Keith Watson, all to no avail !

So, would you please place an announcement in the next issue, as to whether or not there be **any suppliers or repair facilities, willing to accept the challenge of restarting the above disc drive, which is series-connected to three other drives ?**

**David E. Lassov:** Sysop,

SOL BBS @ 520-882-0388 (data )

520-882-3972 (voice)

emanon@azstarnet.com (email)

2590 N. Jordan DR

Tucson AZ 85745-1132

From: GZimmer928@aol.com

To: SPDCommish@aol.com CC: cyherre@juno.com

Hi Bob:

My wife answered your e-mail this morning. I mailed Cy Herre a map on how to get to my house to look over the Sinclair computer equipment. It seems like he cooled off since he hasn't responded.

It includes eight(8) cassette's-word processor, portfolio, business graphics, database, abacus-ss and typing tutor; computer; monitor and printer with two new printer ribbons plus the manuals and two (2) blank cassette's.

**George Zimmerman**

From: "John Kasza" <kaz2@sprint.ca>

To: <akahale@compuserve.com> Date: Mon, 29 Nov 1999

**I have a Timex Sinclair with all the memory etc. is**



it worth anything even to a collector just to get it out of my basement and into someone else hand that would appreciate it would be more that enough.

John Kasza

I am sure that someone would love to provide a home for it. Can you provide your snail Mail address?

**Would you please mention that I am looking for a TS-1510 Cartridge Player**

for the 1000/1500. I have a couple of the cartridges but can't play them. I would buy or trade for one.

The TS-1510 is a module that plugs onto the back of the 1000 or 1500 and allows you to play any of the 4 cartridges that Timex made for those computers. As I mentioned, I have a couple of the cartridges but I can't use them without the 1510. It came out at the same time as the 1500, 2020, 2040, 2050, 2068, & 2090, just before Timex stopped the computer division. I suspect that there were not very many of them and that they are all broken or thrown away by now.

Jack Boatwright  
67325 Fryrear Rd.  
Bend, OR 97701

<jboatno4@outlawnet.com>

Dave,

Just got a post card from Donald Lambert, Here is what it says:

ISR The Disk Drive Specialists 800 458-6778  
Call for shipping number  
Infinite Service & Repair  
2217 Downing Ln.  
Leander TX 78641  
512 259-3444

Thanks a lot, Abed, and don't forget to thank Don, also!  
I KEEP ON TIMEX'n

Dave Lassov

Bob,

When Don moved from Auburn, Indiana he gave me his forwarding address to send him a CD of Z88 programs that had gotten vastly delayed. I now have them, as well as (1) a new 1999 Spectrum CD that you have never seen (it even has Spectrum 128K emulators with it) (2) Atari 2600 CD with very good emulator and 500 classic 2600 games.

I lost Dons address, so can you provide it for me?

Thanks, Frank Davis

Hi Abed,

Finally got on the internet. Spent hours trying to get on and finally learned that I could only use a seven digit telephone number. I thought the local connection was very busy. Have already received an email so I know the service is working now. I am now in the learning curve to get into the mysteries of the internet.

Don Lambert

dslambert@compaq.net

Abed,

The RAM and ROM are presently mapped into the dock space using the ROSCS from the 2068 connector (I have not been able to find a source to tell me how to use the bank selection logic in the 2068 CPLD). At any rate,

I am presently fixing the self-inflicted wounds caused by wiring errors (yes, it's point-to-point hand wired [weird?]) and design errors. I should have the hardware wrung out by the first of the year. It will take this long because I am doing this in my "spare" spare time.

Would the T/SNUG be interested in some written information on this project. I can submit it in PDF format. I can include schematics and a description of the design and updates as available on the drivers.

I am also in the process of disassembling and commenting the system ROMs for the 2068. Is there a source of commented code out there? I have the Spectrum disassembly, but there are enough differences (and the comments are in German) that it is more trouble than it is worth. I am using Ian Logan's disassembly of the ZX-81 as a guide.

Jeff Burrell

JBurrell@endocardial.com

Contributions are most welcomed.

I thought you might be interested in this item, that I found in a newsletter that I receive. I've never seen the Spectrum 128K computer up close. Fred Henn, mentioned that I should pass this along to you, for any members of T/SNUG who would be interested in the Spectrum 128 computer. Thanks!

Dane Stegman

40  
LITTLE NITE  
Cassette/128K's

MAGICLAND  
Cassette/128K's

SCORPION  
Cassette/128K's

THE BEST BEYOND  
1 PAR/GAMES  
SHADOWWALK/128K's  
ENIGM FORT/128K's  
DOORWAY'S REVENGE!  
FOR A  
COURTESY'S SHADOWWALK  
128K's

INDIANA JONES  
TEMPLE OF DOOM

L.E.D. STORM

IMPOSSIBLE MISSION 2  
Cassette/128K's 128K

VIDEO MANIA  
"SEE US NOW IF YOU WANT  
TO APPROVE THE BEST 128K'S"

VIDEO MANIA SEARCHING FOR

128K's  
BEST OFFER  
128K's

# From The Chairman's Disk

Donald S. Lambert

**I** finally learned enough about my new PC bought in September. I bought a Compaq Presario 5715 which has a 13 Gig hard-drive, ZIP drive and the usual other enhancements. A Lexmark Z11 printer and a USB Visioneer scanner filled out the list of extras that I needed. But I surely do miss the convenience of using the T/S 2068. Now when I want to use a computer I turn it all on and wait while the programs get loaded and go through the password thing.

**A** new computer is like a new baby: When you bring them home from the hospital or store is when you find that you need this or that doodad to get going. After I got it unboxed and put together, I found that I lacked a mouse pad so off to Staples to get one. Staples is very close to where we live; perhaps, less than a half mile. So I walk over to the store.

**T**o get the computer registered with Compaq I had to do it by modem through a toll free number - the computer knew the number I didn't - and I kept getting a message "MODEM not turned on" After several tries it dawned on me that maybe the cord that I had used from computer to the telephone wall outlet was bad. I tested it with a telephone and it was dead. Changed cords and it worked the next time I fired up the computer. I will get on the internet as soon as I get more comfortable with the computer.

**T**his is a new house and it takes a lot of extra time to get things set up the way we like it. Trying to get grass to grow is something else. I have to water almost everyday since it has rained only four times since we moved on the 27th of July. Here in Forsyth they put two water meters on the new houses. One is the outside faucets and the other is the normal water usage. That way you don't pay sewer rate on the water you use to water the lawn. I don't think that the outside meter registers what we use for the lawn since we pay the minimum rate for water for that. And all that takes time from my computing.

**I** checked the D cells on the set of Renewal RAY-O-VAC batteries that power the Z88 on turn off and I can't detect any voltage drop. I would say that D cells is

the way to go except that they make a heavy addition to the weight of the Z88 and are a bulky addition to the neatness of the Z88. I will have to get back to using the Z88 or learning to use it. I have the hardware and software to upload/download to and from a PC so I need to try that out sometime.

**E**ver since we moved to Indiana we have not had to change the clocks for daylight savings time or back, here we had to. Yuck! I never realized that we had so many clocks, watches or devices with clocks in them. The Compaq computer had already made the change without asking me but had a screen to ask if that was O.K. Just now I realized that I have one more to change - the Z88. One more besides that which is a sort of telephone number note retainer which is a calculator sized gadget. Yes! I collect junk and store giveaways.

**I** use Wordpad which is a simple wordprocessor that is part of Windows and is rather simple but can do a lot of things. But! I do miss MSCRIPT probably since I used it so many years. When I get better at this computer I will move up to Word 6 which has more bells and whistles.

**I**n the process of connecting up my computer, I had all those cords and cables so I used a spiral wraparound cable bundler. They are available at Radio Shack and some discount lumber yards in the electrical area. I did end up tying some together with cord string spaced about every nine inches or so. I did make the cables look far more neater. On the keyboard pullout shelf where I had the mouse, I soon found that the weight of the cord would pull the mouse to the back of the shelf. I fastened a wood spring clothes pin the back edge of the shelf to grip the cord. That works just fine and I also saw later a reference to tie the free mouse cord to the keyboard cord. I pass along that since I had a problem with the joystick cable back when I had a joystick connected up to the T/S 2068 and the cord seemed to get tangled easily. By fastening it that way would have eliminated the problem. 0/0.

## Changing the Permanent Screen Attributes From Within a HiSoft Pascal® Program

Article And Program By David Solly

The ZX Spectrum and the Timex/Sinclair 2068 have four screen attributes which are controlled in Sinclair basic by the key words ink, paper, bright & flash. These attributes can be either temporary — affecting only the current text, or, they can be permanent — affecting the entire screen.

The *Turtle Graphics* package, which is shipped with HiSoft Pascal, provides the procedures ink() and paper() for changing the temporary attributes. The permanent screen attributes, however, are those that are in force when your Pascal program starts. Should red ink on flashing,

bright magenta paper be the permanent attributes set when your Pascal program is launched then thus they shall remain until the program ends. . . until now.

### PRESENTING PATTRIBUTES()

A flexible HiSoft Pascal procedure for controlling the permanent screen attributes.



## Background Information

The system variable **attr p**, which controls the permanent screen attributes, is located at memory address 23693d or #5C8D.i When the ZX Spectrum or the Timex/Sinclair 2068 is first switched on, **attr p** is set to a default value of #38, that is, black ink on white paper with brightness and flashing switched off.

The eight bits of **attr p** are divided into three bits for ink color, three for paper color, one for bright and one for flash as shown in the table above.

ATTR P							
#07	#06	#05	#04	#03	#02	#01	#00
Flash	Bright	Paper Color			Ink Color		

Paper and ink values are determined according to the *Ink & Paper Table*. The value for flash is #40 and the value for bright is #80. To use the chart, find the values for the ink and paper you desire and add them together. If flash or bright is desired then add its value to the sum obtained for the ink and paper combination. For example: If you poke **attr p** with #CD you will obtain cyan ink on

INK & PAPER TABLE (Hexadecimal & Binary Values)				
Color	Ink		Paper	
Black	#00	000	#00	000xxx
Blue	#01	001	#08	001xxx
Red	#02	010	#10	010xxx
Magenta	#03	011	#18	011xxx
Green	#04	100	#20	100xxx
Cyan	#05	101	#28	101xxx
Yellow	#06	110	#30	110xxx
White	#07	111	#38	111xxx

flashing bright blue paper. To understand this a bit better, let us look at #CD as a binary number.

When we analyze this, we discover that bits #07 and #06, which control flash and bright, have both been set to 1 which means these attributes are active. Bits #03 to #05, which control paper color, contain the binary value 001 which when multiplied by eight gives 001000 which indicates blue paper. Bits #00 to #02 contain the binary value 101 which indicates cyan ink. In all, there are 256 possible combinations of ink, paper, flash and bright.

### The PATTRIBUTES() Procedure

Now to show how this information is used within the procedure `pattributes()` which allows us to modify the permanent screen attributes from within a Pascal program.

```
procedure pattributes(ink, paper : integer;
    bright, flash : boolean);
```

As expected, the procedure takes one argument for each of the four permanent screen attributes. To recreate

ATTR P Set To The Value #CD							
#07	#06	#05	#04	#03	#02	#01	#00
1	1	0	0	1	1	0	1
Flash	Bright	Paper Color			Ink Color		

the set of attributes we have used above within a Pascal program, we would call the procedure thus:

```
pattributes(5, 1, true, true);
```

The procedure takes the first value, 5, as the value for the ink color. After checking that it is within the acceptable range of 0 to 7, it saves it to the local variable **li**, otherwise, the program is halted and a "Bad ink color" message is displayed.

Next the procedure takes the second value, 1, which is the value for the paper color. Here, however, if the number is within range, it is then multiplied by eight to bring it into the range of paper colors. The result is then added to the local variable **li** which now contains the value #0C which translates as cyan ink on blue paper.

The flash and bright attributes are handled by variables of type boolean because they can only be turned either on or off. In our example, they are both to be turned on so the values passed are both "true". This cause #40 and #80 to be added to the local variable **li**. The total value of **li** is now #CD.

The procedure has now completed the calculation part of its task but before it can poke **attr p** with this new value, it must first be converted from two byte variable to a one byte variable. If this were not done then the value of mask **p**, which is the next system variable, would also be changed causing unpredictable results.

```
lpatts := chr(li);
```

With the above command, the procedure transfers the value contained in the two byte integer type variable **li** to the one byte character type variable **lpatts**. Now the procedure can safely execute the command:

```
poke(attrp, lpatts);
```

The last step is to execute the command

```
inline(#CD, #AF, #0D);
```

which calls the ZX Spectrum rom routine `cl_all` that clears the screen and activates the new permanent attributes 2.

### The Source Code & Demo

```
PROGRAM PERMATTS;
```

```
{
```

```
This is a HiSoft Pascal Program.
Works in both 31 and 51 column modes.
Contains some ZX Spectrum specific
inline code.
```

```
Purpose:
```

```
A flexible procedure for changing
the permanent
screen attributes.
```

```
History:
```

```
Program by David Solly
Ottawa, ON, Canada
September 11, 1999
```

```
}
```

```
VAR
```

```
BACKGROUND, FOREGROUND : INTEGER;
```

```

BLINK, HI : BOOLEAN;
ANS : CHAR;
PROCEDURE PATTRIBUTES (
  INK, PAPER : INTEGER;
  BRIGHT, FLASH : BOOLEAN);
CONST
  ATTRP = #5C8D;
VAR
  LPATTS : CHAR;
  LI : INTEGER;
BEGIN
  IF (INK IN [0..7]) THEN
    LI := INK
  ELSE
    BEGIN
      WRITELN;
      WRITELN('Bad ink color');
      HALT
    END;

  IF (PAPER IN [0..7]) THEN
    LI := LI + (PAPER * 8)
  ELSE
    BEGIN
      WRITELN;
      WRITELN('Bad paper color');
      HALT
    END;

  {Switch on the FLASH and BRIGHT
  attributes if requested}
  IF FLASH = TRUE THEN
    LI := LI + #80;
  IF BRIGHT = TRUE THEN
    LI := LI + #40;
  {Convert from an integer value, (2
  bytes) to a character value, (2
  bytes)}
  LPATTS := CHR(LI);
  POKE(ATTRP, LPATTS);
  {The following inline code is
  ZX Spectrum specific.
  It is a call to the CL_ALL ROM
  routine which clears the screen and
  initiates the new attributes.
  For the Timex/Sinclair 2068 use:
  #CD, #EA, #08.}
  INLINE(#CD, #AF, #0D);

```

```

END;

BEGIN {MAIN PROGRAM}
PAGE;
WRITE('PERMANENT ATTRIBUTES TEST');
WRITELN;
WRITELN;
WRITELN;
WRITE('INK? > ');
READLN;
READ(FOREGROUND);
WRITE('PAPER? > ');
READLN;
READ(BACKGROUND);
WRITE('BRIGHT? > ');
READLN;
READ(ANS);
IF ANS = 'Y' THEN
  HI := TRUE
ELSE
  HI := FALSE;
WRITE('FLASH? > ');
READLN;
READ(ANS);
IF ANS = 'Y' THEN
  BLINK := TRUE
ELSE
  BLINK := FALSE;
PAGE;
PATTRIBUTES(FOREGROUND, BACKGROUND, HI,
BLINK);
WRITELN;
WRITELN;
WRITELN('THIS HAS BEEN A TEST OF THE
PATTRIBUTES PROCEDURE');
WRITELN;
WRITELN;
END

```

- 1 Hexadecimal notation is used in HiSoft Pascal to prevent "2's compliment" errors when addressing or modifying system variables. HiSoft Pascal uses the hash mark (#) in front of numbers to indicate hexadecimal.
- 2 The code contained within the inline procedure in this command is ZX Spectrum ROM specific. For the Timex/Sinclair use: `INLINE(#CD, #EA, #08);` instead.

# Z80 WorkShop

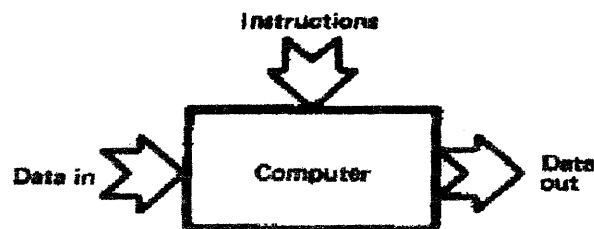
by E. A. Parr

## Chapter One

### The Microcomputer

#### 1.1 Introduction

A computer based on the Z-80 operates in the same manner as any other machine be it micro, mini or mainframe. Before we can discuss the Z-80 and its use in any detail, it is first necessary to describe the operation of a typical microcomputer. This will serve to define the terms used in the rest of the book, and place the Z-80 in its role as the central processor of a powerful, but conventional computer.



#### 1.2 Computer Architecture

All computers can be represented by the block

diagram of Fig.1.1, and can be considered as manipulators of data. The actual form of the data will depend on the application. In commercial computing the data will be VAT returns, sales figures, bank accounts and similar information. In industrial control, the data will be plant sensors and actuators. In a computer game the data will be the players hand controls and the video display. The data can be split into input data, which is to be processed, and the output data, which is the result of the processing. To produce the output data, the computer follows a set of procedures, called instructions, which define the operations that are to be performed on the input data.

The computer can be represented in more detail by Fig.1.2, and can be considered to consist of three basic units, a store, an input/output unit and a central processor unit, all interconnected by a common highway. The input and output unit obviously receives and transmits data from and to the outside world.

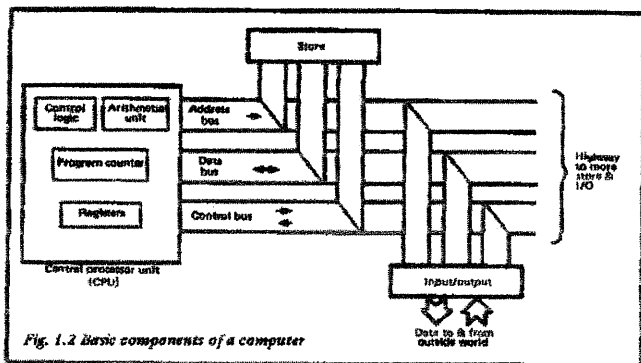


Fig. 1.2 Basic components of a computer

The store is used to hold instructions and data. The central processor unit controls the operation of the machine, and performs the logic and arithmetic operations required by the instructions.

The store is used to hold the instructions and temporary data in the form of numbers. It can best be considered as an array of pigeon holes, each of which can hold one number called (rather confusingly) a Word. Each pigeon hole is known as a store location, and has a unique address (similar to a house address) by which it can be identified. We can thus say, for example, "store location 3220 contains 127". This means that the pigeon hole whose address is 3220 has the number 127 stored in it.

A typical microcomputer will have over 16000 store locations (although small machines may have less than 1000). All common microprocessors deal basically with 8 bit numbers, often called Bytes. The numbers stored will therefore be in the range 0 to 255. As will be seen later, this is not the restriction that it might at first appear.

### 1.3 The Store

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bit numbers, often called Bytes. The numbers stored will therefore be in the range 0 to 255. As will be seen later, this is not the restriction that it might at first appear.

The store does not differentiate between instructions and data; both are held in exactly the same form. The central processor unit determines whether the number in a particular store location is considered to be an instruction or data.

The store connects to the rest of the computer in a manner similar to Fig.1.3. The three groups of signals are known as the address bus, the data bus and the control bus. (The term bus is short for busbar, sometimes the term highway is used.)

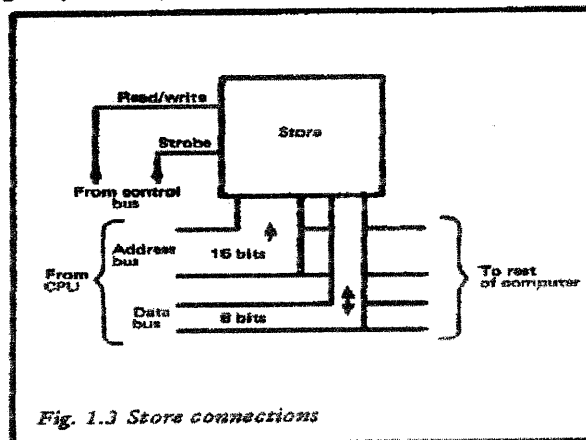


Fig. 1.3 Store connections

The address bus is used by the central processor to identify which store address is to be accessed. Usually, up to 65,536 (called 64K) locations can be used with a microprocessor, necessitating a 16 bit address bus.

The data bus is used to transfer data and instruction between the store and the central processor unit. Movement can take place from store to CPU, or CPU to store, so the data bus is bi-directional. All common microprocessors use an 8 bit data bus.

The control bus contains the timing signals to sequence the movement of data or instructions. In the majority of systems there are basically two signals. A read/write line is used to indicate if a number is to be loaded into or read from, the addressed location, and a strobe signal indicates when the number on the data bus is valid. We, the transients due to different propagation delays, reflections etc. have died away). Different microprocessors use slightly different signals.

Fig. 1.4a summarizes the signals used to write a store location, and Fig. 1.4b the signals used to read from a store location.

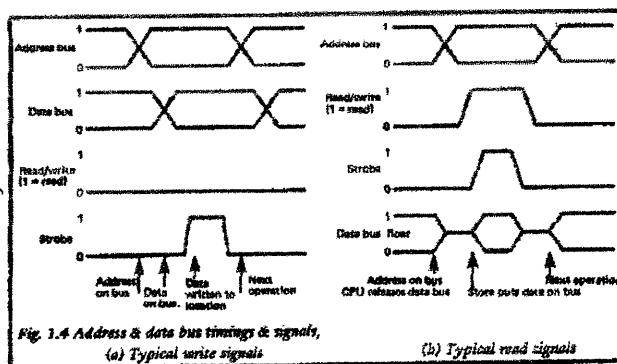


Fig. 1.4 Address & data bus timings & signals, (a) Typical write signals (b) Typical read signals

When a number is written to a store location, the previous contents are obviously overwritten. When a

number is read from a store location, the store location contents are unaltered; the number put onto the data bus is merely a *COPY* of the store contents.

The store in Fig.1.3 is known as a RAM or Random Access Memory. This is a term that causes some confusion, but simply means that each store location can be accessed in exactly the same time. Bulk storage devices, such as tapes and discs, have a variable access time which depends on where the information is stored and where the tape or disc currently is when the information is needed.

Another form of storage commonly encountered is a ROM, for Read Only Memory. This is a conventional store whose contents are fixed and cannot be altered by the computer. Usually a ROM is used to hold a fixed program (such as the BASIC interpreter or an Assembler as described later). To the central processor, a ROM behaves in exactly the same manner as the rest of the store.

#### 1.4 The Central Processor Unit (or CPU)

The computer follows instructions held in the store (in the form of numbers). Normally, instructions are held in sequential store locations. To obey an instruction we must go through the following steps:

- i. Address the store to get the next instruction.
- ii. Decode the instruction to decide what needs to be done
- iii. Obey the instruction. This will usually involve the store again to read, or write, data and will often require simple arithmetic operations.
- iv. Decide where the next instruction is held in the store, and go back to step 1.

Most instructions therefore require two operations on the store; the first to read the instruction, the second to read the data to be used or write a result back to the store. Sometimes the operations above are referred to as three steps:

Fetch cycle (instruction is fetched, steps i and ii)

Execute cycle (instruction is obeyed, step iii)

Reset cycle (the internal logic is reset for the next instruction, step iv)

The FER sequence has been called the heartbeat of a computer.

The component parts of a central processor unit are shown on Fig.1.5. For simplification, internal connections are omitted.

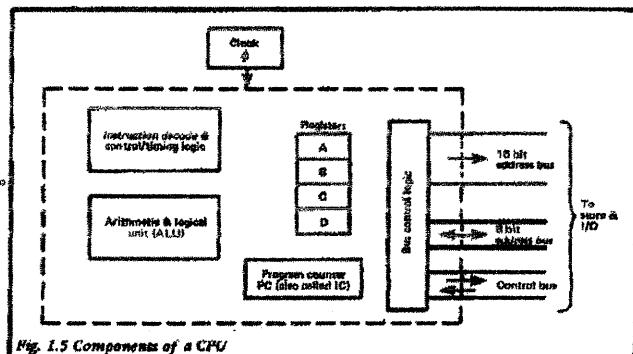


Fig. 1.5 Components of a CPU

The program counter (PC, also known as an instruction counter, IC) holds the address of the current instruction. Because most microcomputers can address up to 64K, the PC will usually be a 16 bit register. With the exception of *JUMP* instructions (the machine code equivalent of a BASIC *GOTO* instruction), the program will be held in sequential store locations. This means that the PC can literally be a counter which is pulsed by the

control logic at step iv above.

In addition to the storage provided by the RAM, fast storage (for temporary scribbling pad purposes) is provided by registers in the CPU. These can hold one number to the same word length as the store {8 bits for all common micros). Some microprocessors (such as the 6502) have only one register, whereas some (such as the Z-80) have as many as sixteen. Fig.1.5 shows four registers for illustrative purposes. The use of registers will be described later.

Associated with the registers is the Arithmetic and Logic Unit (or ALU). There are actually very few machine code instructions; as we shall see later, most are variations on:

Fetch a number from a store location (or input port) to a register.

Write a number to a store location (or output port) from a register.

Add (or subtract) a number from a store location to a register, result to a register.

The ALU performs the arithmetical operations (and some logical operations such as AND, OR) required by the instructions.

Finally, we have the block labeled control/timing logic. This contains the logic to decode the instructions and sequence the steps i to iv above. This involves selecting routes between the store, the ALU, the registers and the highways. The control/timing logic is usually the most complex part of a computer.

Associated with the control logic is a simple clock oscillator which provides the basic timing pulses. Usually this is a crystal oscillator in the range 1 to 4 MHz.

A microprocessor is often thought of as a computer, but is, in fact, simply the CPU of a computer. A microprocessor contains the elements of Fig 1.5, but needs external RAM/ROM and Input/Output equipment to be useful.

#### 1.5 Input And Output

A computer connects to a variety of I/O equipment, printers, keyboards, VDUs, cassette recorders etc. These connect to the computer highway as shown on Fig.1.6. Each I/O device is identified by an address. I/O addresses are commonly known as 'Ports', so we could have, say, a printer connected to Port 3 and a keyboard to Port 5.

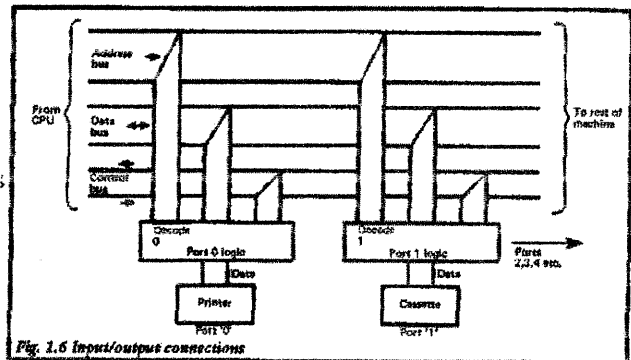


Fig. 1.6 Input/output connections

Data is transferred to and from an I/O port via the highway. The port address is placed on the address highway, the read/write control line used to identify the direction of the transfer, and the I/O control line used to signify that the address is a port address, not a store address. Data transfer then takes place via the data

highway. Some microprocessors (such as the 6800) do not have an I/O control line and literally deal with I/O addresses in the same ways and with the same instructions, as store addresses. With these microprocessors a store and a port cannot have the same address.

Most microprocessors allow data to be transferred between I/O ports and registers or between I/O ports and store locations we shall discuss later the techniques used to resolve the vast difference in speed between slow speed devices (such as printers) and the computer itself.

### 1.6 Instructions And Programs

As anyone who has written a program in BASIC will know, a computer simply obeys a sequence of instructions called a program. In a high level language such as BASIC or PASCAL, these instructions are written in 'English'. A computer actually obeys instructions represented by numbers called a machine code program. When a high level program is obeyed, a special program built into the computer (called a compiler or an interpreter) converts the high level language program to an equivalent machine code program. This action is invisible to the high level language user.

A machine code instruction must specify:

- i. What is to be done (e.g. Add, fetch data, store data, etc.)
- ii. Where the data is to be found, and where the result is to be placed (e.g. "Fetch the data from store location 2000 to Register B", or "Add the data in store location 1575 to the data in Register A putting the result in Register A").

In following chapters we will see how these ideas are actually specified given the limitations of an 8 bit word. There are actually a very limited set of instructions in a computer, and most are variations on:

#### 1.6.1 Fetch

"Fetch data from a specified store location (or register) to a specified register".

#### 1.6.2 Store

"Store data from a specified register to a specified store location". Sometimes Fetch and Store are collectively called "Moves" or "Loads".

#### 1.6.3 Add

"Add data from a specified store location (or register) to the data in another specified store location (or register) the result to go to a specified store location (or register)".

Usually Adds take the simpler form, "Add data from a specified store location to the data in register A, the result to go to Register A".

#### 1.6.4 Subtract

As 1.6.3 but subtraction is performed. Note that multiplication and division are not available on any common microprocessor.

#### 1.6.5 Logical

As 1.6.3, but logical operations such as AND, OR, NEV are performed between the data.

#### 1.6.6 Shifts

Data in a microprocessor is held as 8 bit binary numbers. A shift instruction moves the data in a register up, or down by one place. If we have the bit pattern 10110101, a simple shift up would produce 01101010, and simple shift down would produce 01011010. A shift up multiplies a number by two, a shift down divides by two. As will be seen later, there are many variations on the shift instruction.

#### 1.6.7 lumps

Normally, instructions are held in sequential store locations. A Jump instruction is the machine code equivalent of the BASIC GOTO, and specifies where the next instruction is to be found (e.g. Jump to location 3220).

#### 1.6.8 Conditional lump

A conditional jump tests the condition of a register, the results of which determine if a jump instruction is to be obeyed (e.g. Jump to 4057 if register A is zero). This is the machine code equivalent to the BASIC IF condition THEN GOTO (line number).

#### 1.6.9 Subroutine Call and Return

Programmers in BASIC will be familiar with the concept of a subroutine with the GOSUB and RETURN instructions. A subroutine allows a piece of program that is used frequently to be written once and called when needed by the rest of the program. This is best shown by Fig.1.7. Machine code subroutine calls work in exactly the same way. A subroutine call acts like a jump to the start of the subroutine (e.g. Call 7087 would take us to the subroutine starting at location 7087). A Return instruction is placed at the end of the subroutine, to take us back to the location in the main program immediately after the subroutine call. Subroutines can call subroutines (called Nesting). A Binary to BCD subroutine, for example, would need to use multiplication and division subroutines. In most microprocessors, conditional subroutine calls, and conditional returns are provided as well as the simple call and return described above.

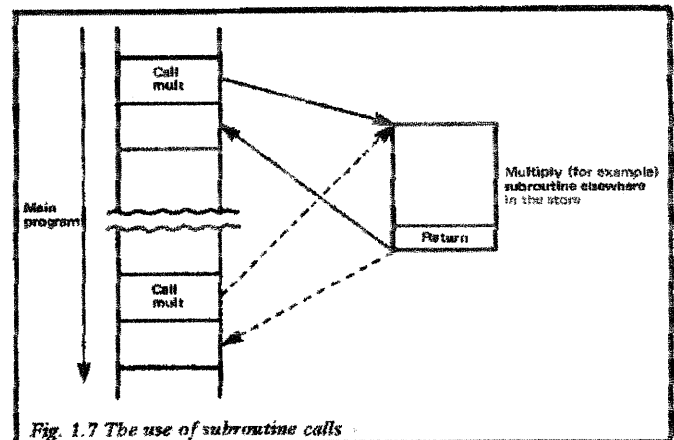


Fig. 1.7 The use of subroutine calls

#### 1.6.10 Input/Output Instructions

Input/output instructions must specify the I/O port address, the direction (in or out) and the source (or destination) of the data (i.e. which register or which store location).

#### 1.6.11 Control Instructions

Most microprocessors have a small number of control instructions such as STOP, Disable Interrupts and similar operations. These do not involve data.

At first sight, the vast array of instructions available on a microprocessor can be rather awe inspiring (the Z-80 has 158 different instruction types). Much of the inevitable feeling of confusion can be assuaged by remembering that most instructions are simple variations of the ten types outlined above.

#### 1.7 Why Machine Code?

Programming in BASIC is simple and straightforward, so it is not unreasonable to ask why one should bother with the trials, tribulations and complexity

of machine code programming. There are really three reasons.

The first is that it is possible to perform operations in machine code that are impossible (or difficult) to achieve in BASIC. Control of external items like a model railway would be difficult in simple BASIC for example.

The second reason concerns speed. BASIC is notoriously slow, and is quite unsuited to, say dynamic video games. Machine code programs operate many times faster than BASIC programs.

The final and most compelling reason is that machine code programming is an intellectual challenge akin to chess or bridge. The mental exercise of programming (in any form) is very addictive and this is particularly true of machine code programs.

### 1.8 Machine Code And Assemblers

The instructions a computer actually obeys are held in the form of binary numbers. To assist human beings to read these numbers, it is usual to express them in Hex, so 1010 0111 becomes A7 (see Appendix A).

A machine code program therefore looks something like:

F5 C5 D6 64 3E Z0 D3 00 etc.  
which is still fairly incomprehensible.

It is easier to follow a machine code program if simple mnemonics are used to represent the instructions. The actual mnemonics used on the Z-80 will be described later,

but in general they are simple to understand. A program written in mnemonics is said to be written in Assembler Language, and looks more understandable.

LD A, 33  
INC HL  
JP NZ, LOOP

Each of these corresponds directly to a single machine code instruction, LD A,33 for example, means put the number 33 into register A.

The program written in Assembler Mnemonics is converted to machine code by a program called (surprise, surprise) an Assembler. The Assembler has editing facilities similar to those found in BASIC and makes machine code programming much less infuriating. In later chapters, examples of Assembler programs will be given. Assemblers are not usually provided with computers, and have to be purchased separately.

### 1.9 Further Reading

The description of computer architecture in this chapter has, of necessity, been rather brief. More detailed discussions can be found in the following books also published by Bernard Babani (publishing) Ltd:

Book No. BP72 - A Microprocessor Primer  
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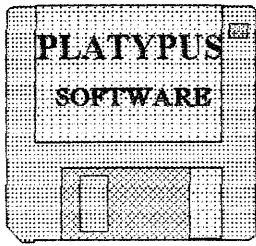
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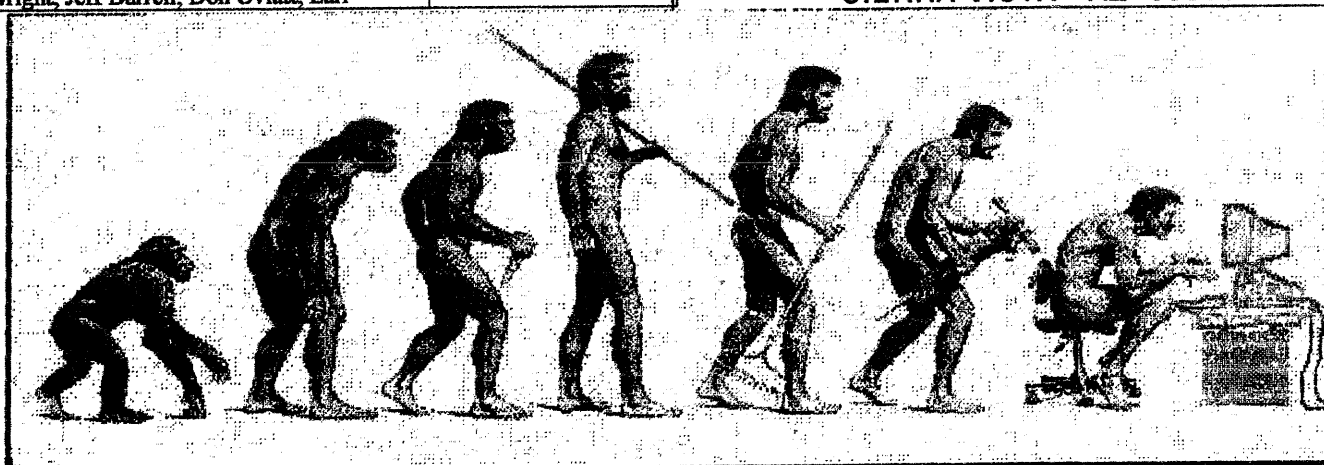
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